# PATENT ABSTRACTS OF JAPAN

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(71)Applicant : TOYO KOHAN CO LTD

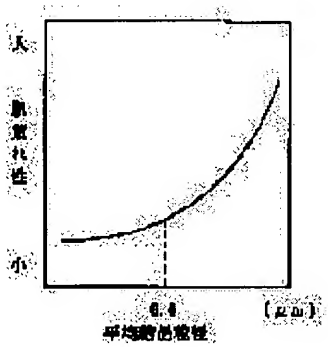
(72)Inventor : SATO DAIZO
SHIMIZU KEIICHI
NISHIYAMA SHIGEYOSHI
FUKUYAMA SATOSHI

## (54) STEEL SHEET SUITABLE FOR USE IN THIN DEEP-DRAWN CAN, AND ITS PRODUCTION

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a steel sheet excellent in surface roughing characteristic and corrosion resistance, free from can body breakage at the time of continuous high speed can manufacture, having superior workability, and suitable for thin deep-drawn can, and its production.

SOLUTION: The steel sheet can be produced by subjecting a hot rolled steel plate, having a composition consisting of 0.01-0.15% C, ≤ 0.05% Si, ≤0.9% Mn, ≤0.04% P, ≤0.04% S, 0.015-0.10% Al, 0.0020-0.015% N, and the balance Fe with inevitable impurities, to cold rolling, continuous annealing by means of a heat cycle containing overaging treatment, and temper rolling at 0.5-2.0% elongation percentage in succession. Further, the average crystalline grain size of the steel sheet after temper rolling is regulated to ≤6.0μm.



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Examiner's Copy

AN 1998-163811 [15] WPIDS
CR 1995-110989 [15]
DNC C1998-052975
TI Steel plate for deep drawing to thin pad used in manufacture - has predetermined **grain** size and percentage **elongation** after temper rolling with annealing.
DC M24 M27
PA (TOJO) TOYO KOHAN CO LTD
CYC 1
PI JP 10030152 A 19980203 (199815)* 6p <--
ADT JP 10030152 A Div ex JP 1993-197825 19930714, JP 1997-100770 19930714
PRAI JP 1993-197825 19930714; JP 1997-100770 19930714
AB JP 10030152 A UPAB: 19980410
The steel plate contains **carbon** of 0.01-0.15%, silicon less than 0.05%, **manganese** less than 0.9%, phosphorus less than 0.04%, sulphur less than 0.04%, aluminium of 0.015-0.1% and **nitrogen** of 0.0020-0.015% with remainder **iron** and impurity. The plate is subjected to temper rolling with annealing, in a thermodynamic cycle comprising hot rolling, cold rolling and overaging process carried in predetermined sequence. After subjecting to thermodynamic cycle, the percentage **elongation** lies between 0.5-2% and the crystalline **grain** size of 6micrometers or less.

ADVANTAGE - The plate improves workability, excels in surface deterioration prevention property and corrosion resistance and suits for continuous high speed canning process.

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CLAIMS

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[Claim(s)]
[Claim 1] The steel plate which performed annealing by the thermo cycle which includes cold rolling and overaging processing for the hot rolled sheet steel which consists of the remainder Fe and an unescapable impurity, and temper rolling with a pace of expansion of 0.5 - 2.0% one by one C:0.01 - 0.15%, Si<=0.05%, Mn<=0.9%, P<=0.04%, S<=0.04%, aluminum:0.015-0.10%, and N:0.0020 to 0.015%, and fitted the thinning deep-drawing can use whose diameter of average crystal grain of the steel plate after temper rolling is 6.0
[Claim 2] C:0.01 - 0.15%, Si<=0.05%, Mn<=0.9%, P<=0.04%, S<=0.04%, aluminum:0.015-0.10%, N:0.0020 - 0.015%, The hot rolled sheet steel which consists of the remainder Fe and an unescapable impurity Nb:0.001-0.020% The steel plate which performed annealing by the thermo cycle including cold rolling and overaging processing, and temper rolling with a pace of expansion of 0.5 - 2.0% one by one, and fitted the thinning deep-drawing can use whos diameter of average crystal grain of the steel plate after temper rolling is 6.0 micrometers or less.
[Claim 3] Continuous annealing in the thermo cycle which includes cold rolling and overaging processing for the ho rolled sheet steel which consists of the remainder Fe and an unescapable impurity C:0.01 - 0.15%, Si<=0.05%, Mn<=0.9%, P<=0.04%, S<=0.04%, aluminum:0.015-0.10%, and N:0.0020 to 0.015%, the manufacturing method of the steel plate suitable for the thinning deep-drawing can use which performs temper rolling with a pace of expansio of 0.5 - 2.0% one by one.
[Claim 4] Annealing by the thermo cycle which includes cold rolling and overaging processing for the hot rolled she steel which consists of the remainder Fe and an unescapable impurity C:0.01 - 0.15%, Si<=0.05%, Mn<=0.9%, P<=0.04%, S<=0.04%, aluminum:0.015-0.10%, N:0.0020 - 0.015%, and Nb:0.001-0.020%, the manufacturing meth of the steel plate suitable for the thinning deep-drawing can use which performs temper rolling with a pace of expansion of 0.5 - 2.0% one by one.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] About container material, such as a food can and a drink can, especially this invention is excellent in deep-drawing processability, and its surface deterioration nature is good and relates to the steel plate suitable for the corrosion resistance outstanding thinning deep-drawing can use, and its manufacturing method.
[0002]
[Description of the Prior Art] conventionally, as a method of fabricating a side non-joint (side -- seamless) can, a res film is beforehand covered to the method of giving an organic paint within and without the can after fabricating a surface treated steel sheet, and the metal plate before fabrication, a resin film is used as a kind of forming lubricant, a there is the so-called thinning drawing can fabricating method which carries out the thinning of the metal plate of the portion used as a can side attachment wall As a latter example, this invention persons proposed the metal plate excellent in the surface deterioration-proof nature after canning, and corrosion resistance for thinning drawing cans previously by specifying the diameter of average crystal grain and average surface roughness of a metal plate (refer t JP,4-314535,A).
[0003]
[Problem(s) to be Solved by the Invention] However, when a thinning drawing can is fabricated using the convention metal plate which covered the resin film beforehand, there is a problem of a surface deterioration plain-gauze cone in the can side attachment wall after completion extremely. That is, the path clearance of a dice and punch is larger than the thickness of a can side attachment wall, and since a can side attachment wall is not restrained by punch and the d but serves as the so-called free surface at the time of processing, compared with the DI (Draw and Ironing) fabricatin method, there is a problem of a surface deterioration plain-gauze cone in a can side attachment wall. If this surface deterioration state arises, the adhesion force of a negative and a film will decrease and it will also become the cause o film ablation. Moreover, the shock from the outside, such as contact of the cans under transportation, becomes a trigger, and surface deterioration makes a film plane produce a detailed crack, as a result also has the problem of causing corrosion resistance degradation. Usually, a thinning deep-drawing can pierces cladding to disc-like, and two steps of spinning fabricates this. The thickness of a can side attachment wall is decreased by applying the high blank holder force to a flange at the time of the second step of this spinning (redrawing processing), and performing drawin buckling-of-track processing of a can side attachment wall. In the above-mentioned processing method, since redrawing processing was the very severe fabricating method, there was a problem that body breaking tends to happe at the time of continuous molding. If such body breaking happens, in order to spoil the productivity of high-speed canning processing, it was pressing need to develop the steel plate suitable for the thinning deep-drawing can use wh body breaking could not happen easily and was moreover excellent in processability. Surface deterioration nature an corrosion resistance are excellent for the purpose of solving the above-mentioned trouble, and body breaking does no occur at the time of continuation high-speed canning processing, but this invention aims at offering the steel plate suitable for the thinning deep-drawing can use which was moreover excellent in processability, and its manufacturin method.
[0004]
[Means for Solving the Problem] The steel plate suitable for the thinning deep-drawing can use of this invention C:0 - 0.15%, Si<=0.05%, Mn<=0.9%, P<=0.04%, S<=0.04%, aluminum:0.015-0.10%, N:0.0020 - 0.015%, It is the steel plate which performed annealing by the thermo cycle which includes cold rolling and overaging processing for the h

rolled sheet steel which consists of the remainder Fe and an unescapable impurity, and temper rolling with a pace of expansion of 0.5 - 2.0% one by one, and fitted the thinning deep-drawing use whose diameter of average crystal grai of the steel plate after temper rolling is 6.0 micrometers or less. Furthermore, C:0.01 - 0.15%, Si<=0.05%, Mn<=0.9 P<=0.04%, S<=0.04%, aluminum:0.015-0.10%, N:0.0020 - 0.015%, Nb:0.001-0.020%, Annealing by the thermo cy which includes cold rolling and overaging processing for the hot rolled sheet steel which consists of the remainder F and an unescapable impurity, and temper rolling with a pace of expansion of 0.5 - 2.0% are performed one by one, a it is desirable for the diameter of average crystal grain of the steel plate after temper rolling to be also 6.0 micromete or less. Next the manufacturing method of the steel plate suitable for the thinning deep-drawing can use of this invention C:0.01 - 0.15%, Si<=0.05%, Mn<=0.9%, P<=0.04%, S<=0.04%, aluminum:0.015-0.10%, N:0.0020 - 0.015%, Annealing by the thermo cycle which includes cold rolling and overaging processing for the hot rolled shee steel which consists of the remainder Fe and an unescapable impurity, It is the manufacturing method of the steel pla suitable for the thinning deep-drawing use which performs temper rolling with a pace of expansion of 0.5 - 2.0% one by one. Moreover, C:0.01 - 0.15%, Si<=0.05%, Mn<=0.9%, P<=0.04%, S<=0.04%, aluminum:0.015-0.10%, It is als desirable to perform annealing by the thermo cycle which includes cold rolling and overaging processing for the hot rolled sheet steel which consists of the remainder Fe and an unescapable impurity, and temper rolling with a pace of expansion of 0.5 - 2.0% one by one N:0.0020 - 0.015% and Nb:0.001-0.020%.

[0005]

[Embodiments of the Invention] Resin films, such as polyester, are covered to the steel plate of this invention, it pier to disc-like, and the thinning deep-drawing can which body breaking did not occur but was moreover excellent in processability in this even if it performed continuation high-speed canning processing of 2 stage drawing can be fabricated. Especially, it can have the processability and intensity for thinning being carried out remarkably and not producing body breaking in the case of two steps of severe deep drawing in the steel plate of the can use formed into part high intensity in recent years, and surface deterioration and corrosion resistance conditions can be fulfilled as m goods. Namely, since thinning is carried out to a strong back tension in response to strong tension-bending processin by being made from an ultra-thin steel plate at the dice corner where radius of curvature is small in thinning deep drawing under the load of the punch force at a redrawing process, the intensity for not resulting in body-breaking generating in that case is required with the advanced processability which meets the demand of these thinning deep drawing, and, for this reason, the balance of can intensity and processability is important. By combining temper rolli with which a pace of expansion becomes 0.5 - 2.0% after a thermo cycle including the overaging processing after co rolling in this invention Reduction of the dissolution C and N by the overaging processing after cold-rolling is achieved, and operation that an elongation property improves and processability improves, and improvement in the board intensity by the temper rolling after overaging can give conjointly sufficient processability and the intensity which does not produce body breaking in the ultra-thin steel plate for cans. Moreover, although it is just going to be known that addition of Nb will generally contribute to reduction of grain refining and Dissolution C and N By being combined with the thermo cycle of this invention including the overaging processing after cold-rolling With reductio of Dissolution C and N being achieved by overaging processing, and improvement in processability including an elongation property being achieved, conjointly It is increased remarkably and a reduction operation of the dissolution and N in the case of overaging processing can attain the big and rough-ized prevention effect of the crystal grain, and the prevention-of-body-breaking effect [ in / thinning deep drawing / conjointly / in surface deterioration prevention And these operations and effects are demonstrated based on the property by the specific component composition, and can attain grain refining of the crystal grain which regulation of the amount of C and content of the minute amount o Nb contribute to improvement in surface deterioration nature conjointly with these down stream processing especiall

[0006] The component steel component of a hot rolled sheet steel consists of Remainder Fe and an unescapable impurity C:0.01 - 0.15%, Si<=0.05%, Mn<=0.9%, P<=0.04%, S= 0.04%, aluminum:0.015-0.10%, and N:0.0020 to 0.015%. Moreover, what added Nb to the above-mentioned component 0.001 to 0.02% is used suitably. The reason f regulation of a steel component is explained below. When C became less than 0.01%, it caused big and rough-ization of crystal grain, and it made the minimum 0.01%. On the other hand, since spinning nature deteriorated exceeding 0.15%, the range was made into 0.01 - 0.15%. Although Si was an element detrimental to corrosion resistance as a charge of can material, it is an element contained unescapable as aluminum killed steel, and made the upper limit 0.05%. Although Mn was a component required in order to prevent the red shortness under hot-rolling by S which is impurity, since it deteriorated spinning nature as on the other hand exceeding 0.9%, it made the upper limit 0.9%. Although P is a component effective in grain refining and it is added at a fixed rate from raising the intensity of a

negative, corrosion resistance is ****(ed) by one side. When P exceeded 0.04% as a steel-for-can board of this invention use, corrosion resistance and since especially ******-proof fell remarkably, the upper limit was made into 0.04%. S was an impurity component which produces the red shortness under hot-rolling, as much as possible, although the few thing was desirable, is an element contained unescapable and made the upper limit 0.04%. Althoug is added in a steel bath as a deoxidizer and aluminum is removed as a slag on the occasion of steel manufacture, sinc the deoxidation effect stabilized when there were few additions is not acquired, it needs 0.015% or more. Moreover, aluminum reacts with **** N, deposits as AlN, and contributes to grain refining of crystal grain. On the other hand, since there were few technical effects and they were not desirable on economy, the addition exceeding 0.10% made t upper limit 0.10%. since it will be easy to produce a crack on a slab front face and will become a structure defect, if there are few deposits with a nitride when fewer than 0.002%, the effect of grain refining is lost and 0.015% is exceeded on the other hand, although N forms aluminum and Nb, and a nitride and it is a component effective in gra refining of a fine-grain grain -- the range -- 0.002 - 0.015% -- the bottom Nb has an effect in grain refining of crystal grain, and contributes to reduction of Dissolution C and N. when fewer than 0.001%, there was no effect of grain refining, and the upper limit was made into 0.020%, in order for the amount of dissolution Nb(s) to increase and to cause degradation of spinning nature conversely on the other hand, if 0.020% is exceeded

[0007] Although slab heating temperature and hot rolling conditions are not specified by this invention, as for slab heating temperature, it is desirable to consider as 1100 degrees C or more from the standpoint of positive decomposition dissolution of N and stable reservation of hot rolling temperature. It is hot rolling finishing temperatu Ar3 Since it will be made big and rough while the crystalline structure of a hot-rolling board mixed-grain-size-izes if carries out to below a point, hot rolling finishing temperature is Ar3. It carried out to beyond the point. Moreover, sin crystal grain will turn big and rough and surface deterioration will produce winding temperature if it makes a minimu 450 degrees C in consideration of the quality stability of the coil cross direction at the time of hot-rolling, and a longitudinal direction and 650 degrees C is exceeded, winding temperature has the desirable range of 450-650 degre C.

[0008] Since a cold rolling process rolling reduction cannot bring about coarsening of a steel plate, or mixed-grain-si ization at an annealing process and cannot carry out grain refining of the crystal grain enough at less than 75%, as fo the rolling reduction of cold rolling, it is desirable to make 75% into a minimum.

[0009] In the annealing process this invention, it became clear by adopting annealing by the thermo cycle including overaging processing that an effect is in body breaking. This is considered to be based on what Dissolution C and N reduced. Which art in the case where overaging processing is performed by continuous-annealing processing as it is, and the case of once lowering the temperature and performing box annealing processing anew is sufficient as anneal after continuous annealing. Although what is necessary is just to be more than a recrystallizing temperature, since bi and rough-ization of crystal grain will break out if 750 degrees C is exceeded, the processing temperature of continu annealing of a preceding paragraph story is not desirable. In addition, the overaging processing said here means heat treatment in low temperature and a long time as compared with general annealing processing. Overaging processing performs soaking for 1 - 3 minutes at 400-550 degrees C, when carrying out after continuous annealing. At less than 400 degrees C, Dissolution C and N cannot be reduced, but if 550 degrees C is exceeded, crystal grain will make it b and rough. Moreover, in less than 1 minute, reduction of Dissolution C and N cannot be aimed at enough, but if 3 minutes is exceeded, in order that a length of chamber may make it huge, it considers as the range for 1 - 3 minutes. Moreover, box annealing is sufficient as overaging processing. When based on box annealing, the once lowered temperature is raised to 400-550 degrees C, and soaking is performed for 2 to 10 hours. The quality as overaging processing is not stabilized but a property differs in less than 400 degrees C. If 550 degrees C is exceeded, crystal gr will make it big and rough like continuous annealing. The quality as overaging processing is not stabilized but a property varies in less than 2 hours. On the other hand, the processing which passes 10 hours is not an economy top best policy.

[0010] Total elongation falls to the general effect of overaging processing by the increase in Dissolution C and N, an uniform elongation also deteriorates. This is considered because Dissolution C and N is acting on the vena contracta generated at the time of elongation, and the connection mechanism of a void. Overaging processing reduces the dissolution C and N in steel, and an effect is in elasticity-ization of steel. By performing overaging processing, the dissolution C and N among steel is reduced, generating of the vena contracta and connection of a void are suppressed and it is thought that fracture and body-breaking susceptibility are reduced as a result. The steel component range of this invention is required when demonstrating the operation in these overaging processings, and an operation of each

aforementioned component is attained through this overaging processing. Although surface deterioration prevention the existence of the lower limit of the amount of C, aluminum, Nb, etc. is carried out by grain refining of crystal grai especially Nb addition of a minute amount improves processability by demonstrating a reduction operation of the dissolution C and N conjointly with overaging processing.

[0011] If a pace of expansion is the range which is 0.5 - 2.0%, since generating of a stretcher strain will be prevented this range is suitable for temper rolling temper rolling (the abbreviation for SR and Single Reduce Rolling). While reducing the dissolution C and N in the aforementioned steel by overaging processing, suppressing generating of the vena contracta, and connection of a void, improving the processability in deep drawing and filling with this invention the processing conditions of thinning deep drawing which is the object of this invention By performing temper rollin of the range whose pace of expansion is 0.5 - 2.0%, intensity can be given and the steel plate of this invention can gi the board intensity which combines with the advanced processability for which thinning deep drawing is asked, and does not produce body-breaking generating at the time of processing by this. Thus, in this invention, these two processes are put together and the conditions of processability and each board intensity can be attained. Moreover, th necessary can intensity called for in the can of ultra-thin ** by this temper rolling is also attained.

[0012] Although especially DR rolling DR rolling may be performed when giving the can intensity after fabrication, rolling reduction may be 20 - 50%. At less than 20%, if sufficient can intensity is not obtained but 50% is exceeded, steel plate will serve as high intensity and difficulty will be caused to a can fabricating operation. DR rolling is Doub here. Reduce Rolling It is abbreviation and is the rolling-out method to which decrease board thickness more positiv and board intensity is made to increase from temper rolling. In this invention, it considers as secondary cold-rolling including the above-mentioned temper rolling and DR rolling.

[0013] Next, as a steel plate used for this invention, what performed surface treatment is raised to the steel plate of th shape of the shape of a sheet, and a coil, steel foils, those steel plates, etc. That by which a chromium hydration oxid or the upper layer performed surface treatment with the two-layer structure where a chromium hydration oxide and a lower layer consist of a metal chromium layer to an electrolysis chromate-treatment steel plate [ in which a lower lay has metal chromium and the upper layer has the two-layer structure of a chromium hydration oxide especially ] or ultra-thin tin plated steel plate, and nickel-plating steel plate, galvanized steel sheets, and these plating steel plates is excellent in contact nature with polyester resin.

[0014] Specification of the diameter of the diameter crystal grain of average crystal grain is explained based on drawing 1 and drawing 2 . Drawing 1 shows the relation between the diameter of average crystal grain, and the surfa deterioration nature of the can side attachment wall after canning processing. Drawing 1 shows that the surface deterioration nature of the front face after canning processing deteriorates, when the diameter of average crystal grai becomes large. If the diameter of average crystal grain exceeds 6 micrometers, surface surface deterioration nature w deteriorate and the appearance and the property as a can will be spoiled. For this reason, the diameter of average crys grain decides not to exceed 6 micrometers. Moreover, drawing 2 shows the relation between the diameter of average crystal grain, and corrosion resistance. It turns out that corrosion resistance is good in the range in which the diamete of average crystal grain does not exceed 6 micrometers from drawing 2 , either. In addition, corrosion resistance evaluation was performed as follows. Heat treatment for 20 minutes was performed for the can after canning process at 130 degrees C, it was filled up with water, and viewing estimated the corrosion (melanism) grade of the can inside after 37 degrees C and the two-week passage of time.

[0015]

[Example]

[0016]

[Table 1]

| 鋼種記号 | 鋼の化学成分 (wt%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | C | Si | Mn | P | S | Sol. Al | N | Nb |
| A | 0.06 | 0.03 | 0.35 | 0.011 | 0.011 | 0.044 | 0.0022 | − |
| B | 0.08 | 0.02 | 0.42 | 0.015 | 0.013 | 0.049 | 0.0033 | − |
| C | 0.11 | 0.01 | 0.56 | 0.018 | 0.010 | 0.035 | 0.0027 | − |
| D | 0.15 | 0.03 | 0.60 | 0.010 | 0.010 | 0.052 | 0.0063 | − |
| E | 0.01 | 0.01 | 0.15 | 0.016 | 0.016 | 0.047 | 0.0023 | 0.018 |
| F | 0.03 | 0.02 | 0.21 | 0.013 | 0.012 | 0.043 | 0.0031 | 0.002 |
| G | 0.002 | 0.01 | 0.18 | 0.009 | 0.013 | 0.052 | 0.0035 | − |

[0017]
[Table 2]

| | No | 鋼種記号 | 二次冷延 | 焼鈍条件 | 平均結晶粒径（μm） | 肌荒れ性 | 耐食性 | 加工性 | 総合評価 |
|---|---|---|---|---|---|---|---|---|---|
| 本発明 | 1 | A | SR | 有 | 5．6 | ○ | ○ | ○ | ○ |
| | 2 | B | DR | 有 | 5．3 | ◎ | ◎ | ○ | ◎ |
| | 3 | C | DR | 有 | 4．8 | ◎ | ◎ | ○ | ◎ |
| | 4 | D | SR | 有 | 4．3 | ◎ | ◎ | ○ | ◎ |
| | 5 | E | DR | 有 | 5．3 | ◎ | ◎ | ◎ | ◎ |
| | 6 | F | DR | 有 | 6．0 | ◎ | ◎ | ◎ | ◎ |
| 比較例 | 7 | G | DR | 有 | 8．3 | × | × | △ | × |
| | 8 | B | SR | 無 | 5．2 | ◎ | ◎ | △ | △ |
| | 9 | C | DR | 無 | 4．8 | ◎ | ◎ | △ | △ |
| | 10 | D | DR | 無 | 4．2 | ◎ | ◎ | △ | △ |

焼鈍条件：過時効処理を実施しているものを有とした

過時効処理を実施してないものを無とした

[0018] Example No.1-6 of an evaluation this invention are carrying out overaging processing, and they are excellent processability with component within the limits of this invention. The diameter of average crystal grain is 6.0 micrometers or less as shown in Table 2, and it turns out that it excels also with surface deterioration nature and corrosion resistance. Moreover, a result which was excellent also in processability important as a thinning deep-drawing can use of this invention is brought. It turns out that it reaches example No.5 and 6 is especially excellent in processability with Nb addition of a minute amount. On the other hand, example No.of comparison 7 have brought a result which was inferior also in processability, although crystal grain became big and rough, became poor [ surface deterioration nature and corrosion resistance ] and performed overaging processing, since there were few amounts of below at the minimum of this invention range. Although example No.of comparison8-10 are in the component range invention, they do not carry out overaging processing but are inferior in processability. In addition, the evaluation ca was performed as follows here, respectively. Evaluation of surface deterioration nature measured the surface roughn of the can side attachment wall of the can inside after thinning deep-drawing can fabrication, Ra made 1 micrometer less O (best), and it made the 1-1.5-micrometer thing O (good), made the 1.5-2-micrometer thing ** (a little poor), a evaluated 2 micrometers or more as x (poor). Moreover, corrosion resistance evaluation performed heat treatment fo 130 degree-Cx 20 minutes after thinning deep-drawing can fabrication, it was filled up with water, and 37 degrees C estimated the corrosion (melanism) grade of the can inside after the two-week passage of time visually. That in whic the front face has not carried out melanism at all was made into O (best), the grade of melanism made the minute thi O (good), the range of melanism made the thing (diameter of 5mm or less) of smallness ** (a little poor), and the thi of size (diameter of 5mm or more) was evaluated as x (poor). The size of ********** until it raises and carries ou body breaking of the ********** at the time of thinning deep-drawing can fabrication estimated evaluation of processability. What made O (good) what ********** made what carried out body breaking by 5t or less ** (a lit poor), and carried out body breaking by 5-7t, and carried out body breaking by 7t or more was made into O (best).

[0019]
[Effect of the Invention] By this invention, it can excel in surface deterioration nature and corrosion resistance, and body breaking cannot occur at the time of continuation high-speed canning processing, but the steel plate suitable fo the thinning deep-drawing can use which was moreover excellent in processability can be offered. In addition, as a c use, as for the steel plate offered by this invention, a steel plate independent is usable, and it carries out surface treatment to this steel plate, and can use it also as a tin plate, TFS, a nickel-plating steel plate, etc. Furthermore, you may cover resin films, such as polyester, to the above-mentioned surface treated steel sheet. Moreover, what coated t steel plate with paints, such as epoxy, is applicable to a thinning deep-drawing can use.

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[Translation done.]

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TECHNICAL FIELD

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[The technical field to which invention belongs] About container material, such as a food can and a drink can, especially this invention is excellent in deep-drawing processability, and its surface deterioration nature is good and relates to the steel plate suitable for the corrosion resistance outstanding thinning deep-drawing can use, and its manufacturing method.

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[Translation done.]

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PRIOR ART

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[Description of the Prior Art] conventionally, as a method of fabricating a side non-joint (side -- seamless) can, a res film is beforehand covered to the method of giving an organic paint within and without the can after fabricating a surface treated steel sheet, and the metal plate before fabrication, a resin film is used as a kind of forming lubricant, a there is the so-called thinning drawing can fabricating method which carries out the thinning of the metal plate of the portion used as a can side attachment wall As a latter example, this invention persons proposed the metal plate excellent in the surface deterioration-proof nature after canning, and corrosion resistance for thinning drawing cans previously by specifying the diameter of average crystal grain and average surface roughness of a metal plate (refer t JP,4-314535,A).

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EFFECT OF THE INVENTION

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[Effect of the Invention] By this invention, it can excel in surface deterioration nature and corrosion resistance, and body breaking cannot occur at the time of continuation high-speed canning processing, but the steel plate suitable fo the thinning deep-drawing can use which was moreover excellent in processability can be offered. In addition, as a c use, as for the steel plate offered by this invention, a steel plate independent is usable, and it carries out surface treatment to this steel plate, and can use it also as a tin plate, TFS, a nickel-plating steel plate, etc. Furthermore, you may cover resin films, such as polyester, to the above-mentioned surface treated steel sheet. Moreover, what coated t steel plate with paints, such as epoxy, is applicable to a thinning deep-drawing can use.

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TECHNICAL PROBLEM

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[Problem(s) to be Solved by the Invention] However, when a thinning drawing can is fabricated using the convention metal plate which covered the resin film beforehand, there is a problem of a surface deterioration plain-gauze cone in the can side attachment wall after completion extremely. That is, the path clearance of a dice and punch is larger than the thickness of a can side attachment wall, and since a can side attachment wall is not restrained by punch and the d but serves as the so-called free surface at the time of processing, compared with the DI (Draw and Ironing) fabricatin method, there is a problem of a surface deterioration plain-gauze cone in a can side attachment wall. If this surface deterioration state arises, the adhesion force of a negative and a film will decrease and it will also become the cause o film ablation. Moreover, the shock from the outside, such as contact of the cans under transportation, becomes a trigger, and surface deterioration makes a film plane produce a detailed crack, as a result also has the problem of causing corrosion resistance degradation. Usually, a thinning deep-drawing can pierces cladding to disc-like, and two steps of spinning fabricates this. The thickness of a can side attachment wall is decreased by applying the high blank holder force to a flange at the time of the second step of this spinning (redrawing processing), and performing drawin buckling-of-track processing of a can side attachment wall. In the above-mentioned processing method, since redrawing processing was the very severe fabricating method, there was a problem that body breaking tends to happe at the time of continuous molding. If such body breaking happens, in order to spoil the productivity of high-speed canning processing, it was pressing need to develop the steel plate suitable for the thinning deep-drawing can use wh body breaking could not happen easily and was moreover excellent in processability. Surface deterioration nature an corrosion resistance are excellent for the purpose of solving the above-mentioned trouble, and body breaking does no occur at the time of continuation high-speed canning processing, but this invention aims at offering the steel plate suitable for the thinning deep-drawing can use which was moreover excellent in processability, and its manufacturin method.

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MEANS

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[Means for Solving the Problem] The steel plate suitable for the thinning deep-drawing can use of this invention C:0 - 0.15%, Si<=0.05%, Mn<=0.9%, P<=0.04%, S<=0.04%, aluminum:0.015-0.10%, N:0.0020 - 0.015%, It is the steel plate which performed annealing by the thermo cycle which includes cold rolling and overaging processing for the h rolled sheet steel which consists of the remainder Fe and an unescapable impurity, and temper rolling with a pace of expansion of 0.5 - 2.0% one by one, and fitted the thinning deep-drawing use whose diameter of average crystal grai of the steel plate after temper rolling is 6.0 micrometers or less. Furthermore, C:0.01 - 0.15%, Si<=0.05%, Mn<=0.9 P<=0.04%, S<=0.04%, aluminum:0.015-0.10%, N:0.0020 - 0.015%, Nb:0.001-0.020%, Annealing by the thermo cy which includes cold rolling and overaging processing for the hot rolled sheet steel which consists of the remainder F and an unescapable impurity, and temper rolling with a pace of expansion of 0.5 - 2.0% are performed one by one, a it is desirable for the diameter of average crystal grain of the steel plate after temper rolling to be also 6.0 micromete or less. Next the manufacturing method of the steel plate suitable for the thinning deep-drawing can use of this invention C:0.01 - 0.15%, Si<=0.05%, Mn<=0.9%, P<=0.04%, S<=0.04%, aluminum:0.015-0.10%, N:0.0020 - 0.015%, Annealing by the thermo cycle which includes cold rolling and overaging processing for the hot rolled shee steel which consists of the remainder Fe and an unescapable impurity, It is the manufacturing method of the steel pla suitable for the thinning deep-drawing use which performs temper rolling with a pace of expansion of 0.5 - 2.0% one by one. Moreover, C:0.01 - 0.15%, Si<=0.05%, Mn<=0.9%, P<=0.04%, S<=0.04%, aluminum:0.015-0.10%, It is als desirable to perform annealing by the thermo cycle which includes cold rolling and overaging processing for the hot rolled sheet steel which consists of the remainder Fe and an unescapable impurity, and temper rolling with a pace of expansion of 0.5 - 2.0% one by one N:0.0020 - 0.015% and Nb:0.001-0.020%.
[0005]
[Embodiments of the Invention] Resin films, such as polyester, are covered to the steel plate of this invention, it pier to disc-like, and the thinning deep-drawing can which body breaking did not occur but was moreover excellent in processability in this even if it performed continuation high-speed canning processing of 2 stage drawing can be fabricated. Especially, it can have the processability and intensity for thinning being carried out remarkably and not producing body breaking in the case of two steps of severe deep drawing in the steel plate of the can use formed into part high intensity in recent years, and surface deterioration and corrosion resistance conditions can be fulfilled as m goods. Namely, since thinning is carried out to a strong back tension in response to strong tension-bending processin by being made from an ultra-thin steel plate at the dice corner where radius of curvature is small in thinning deep drawing under the load of the punch force at a redrawing process, the intensity for not resulting in body-breaking generating in that case is required with the advanced processability which meets the demand of these thinning deep drawing, and, for this reason, the balance of can intensity and processability is important. By combining temper rolli with which a pace of expansion becomes 0.5 - 2.0% after a thermo cycle including the overaging processing after co rolling in this invention Reduction of the dissolution C and N by the overaging processing after cold-rolling is achieved, and operation that an elongation property improves and processability improves, and improvement in the board intensity by the temper rolling after overaging can give conjointly sufficient processability and the intensity which does not produce body breaking in the ultra-thin steel plate for cans. Moreover, although it is just going to be known that addition of Nb will generally contribute to reduction of grain refining and Dissolution C and N By being combined with the thermo cycle of this invention including the overaging processing after cold-rolling With reductio of Dissolution C and N being achieved by overaging processing, and improvement in processability including an elongation property being achieved, conjointly It is increased remarkably and a reduction operation of the dissolution and N in the case of overaging processing can attain the big and rough-ized prevention effect of the crystal grain, and

the prevention-of-body-breaking effect [ in / thinning deep drawing / conjointly / in surface deterioration prevention And these operations and effects are demonstrated based on the property by the specific component composition, and can attain grain refining of the crystal grain which regulation of the amount of C and content of the minute amount o Nb contribute to improvement in surface deterioration nature conjointly with these down stream processing especiall
[0006] The component steel component of a hot rolled sheet steel consists of Remainder Fe and an unescapable impurity C:0.01 - 0.15%, Si<=0.05%, Mn<=0.9%, P<=0.04%, S= 0.04%, aluminum:0.015-0.10%, and N:0.0020 to 0.015%. Moreover, what added Nb to the above-mentioned component 0.001 to 0.02% is used suitably. The reason f regulation of a steel component is explained below. When C became less than 0.01%, it caused big and rough-ization of crystal grain, and it made the minimum 0.01%. On the other hand, since spinning nature deteriorated exceeding 0.15%, the range was made into 0.01 - 0.15%. Although Si was an element detrimental to corrosion resistance as a charge of can material, it is an element contained unescapable as aluminum killed steel, and made the upper limit 0.05%. Although Mn was a component required in order to prevent the red shortness under hot-rolling by S which is impurity, since it deteriorated spinning nature as on the other hand exceeding 0.9%, it made the upper limit 0.9%. Although P is a component effective in grain refining and it is added at a fixed rate from raising the intensity of a negative, corrosion resistance is ****(ed) by one side. When P exceeded 0.04% as a steel-for-can board of this invention use, corrosion resistance and since especially ******-proof fell remarkably, the upper limit was made into 0.04%. S was an impurity component which produces the red shortness under hot-rolling, as much as possible, although the few thing was desirable, is an element contained unescapable and made the upper limit 0.04%. Althoug is added in a steel bath as a deoxidizer and aluminum is removed as a slag on the occasion of steel manufacture, sinc the deoxidation effect stabilized when there were few additions is not acquired, it needs 0.015% or more. Moreover, aluminum reacts with **** N, deposits as AlN, and contributes to grain refining of crystal grain. On the other hand, since there were few technical effects and they were not desirable on economy, the addition exceeding 0.10% made t upper limit 0.10%. since it will be easy to produce a crack on a slab front face and will become a structure defect, if there are few deposits with a nitride when fewer than 0.002%, the effect of grain refining is lost and 0.015% is exceeded on the other hand, although N forms aluminum and Nb, and a nitride and it is a component effective in gra refining of a fine-grain grain -- the range -- 0.002 - 0.015% -- the bottom Nb has an effect in grain refining of crystal grain, and contributes to reduction of Dissolution C and N. when fewer than 0.001%, there was no effect of grain refining, and the upper limit was made into 0.020%, in order for the amount of dissolution Nb(s) to increase and to cause degradation of spinning nature conversely on the other hand, if 0.020% is exceeded
[0007] Although slab heating temperature and hot rolling conditions are not specified by this invention, as for slab heating temperature, it is desirable to consider as 1100 degrees C or more from the standpoint of positive decomposition dissolution of N and stable reservation of hot rolling temperature. It is hot rolling finishing temperatu Ar3 Since it will be made big and rough while the crystalline structure of a hot-rolling board mixed-grain-size-izes if carries out to below a point, hot rolling finishing temperature is Ar3. It carried out to beyond the point. Moreover, sin crystal grain will turn big and rough and surface deterioration will produce winding temperature if it makes a minimu 450 degrees C in consideration of the quality stability of the coil cross direction at the time of hot-rolling, and a longitudinal direction and 650 degrees C is exceeded, winding temperature has the desirable range of 450-650 degre C.
[0008] Since a cold rolling process rolling reduction cannot bring about coarsening of a steel plate, or mixed-grain-si ization at an annealing process and cannot carry out grain refining of the crystal grain enough at less than 75%, as fo the rolling reduction of cold rolling, it is desirable to make 75% into a minimum.
[0009] In the annealing process this invention, it became clear by adopting annealing by the thermo cycle including overaging processing that an effect is in body breaking. This is considered to be based on what Dissolution C and N reduced. Which art in the case where overaging processing is performed by continuous-annealing processing as it is, and the case of once lowering the temperature and performing box annealing processing anew is sufficient as anneal after continuous annealing. Although what is necessary is just to be more than a recrystallizing temperature, since bi and rough-ization of crystal grain will break out if 750 degrees C is exceeded, the processing temperature of continu annealing of a preceding paragraph story is not desirable. In addition, the overaging processing said here means heat treatment in low temperature and a long time as compared with general annealing processing. Overaging processing performs soaking for 1 - 3 minutes at 400-550 degrees C, when carrying out after continuous annealing. At less than 400 degrees C, Dissolution C and N cannot be reduced, but if 550 degrees C is exceeded, crystal grain will make it b and rough. Moreover, in less than 1 minute, reduction of Dissolution C and N cannot be aimed at enough, but if 3

minutes is exceeded, in order that a length of chamber may make it huge, it considers as the range for 1 - 3 minutes. Moreover, box annealing is sufficient as overaging processing. When based on box annealing, the once lowered temperature is raised to 400-550 degrees C, and soaking is performed for 2 to 10 hours. The quality as overaging processing is not stabilized but a property differs in less than 400 degrees C. If 550 degrees C is exceeded, crystal gr will make it big and rough like continuous annealing. The quality as overaging processing is not stabilized but a property varies in less than 2 hours. On the other hand, the processing which passes 10 hours is not an economy top best policy.

[0010] Total elongation falls to the general effect of overaging processing by the increase in Dissolution C and N, an uniform elongation also deteriorates. This is considered because Dissolution C and N is acting on the vena contracta generated at the time of elongation, and the connection mechanism of a void. Overaging processing reduces the dissolution C and N in steel, and an effect is in elasticity-ization of steel. By performing overaging processing, the dissolution C and N among steel is reduced, generating of the vena contracta and connection of a void are suppressed and it is thought that fracture and body-breaking susceptibility are reduced as a result. The steel component range of this invention is required when demonstrating the operation in these overaging processings, and an operation of each aforementioned component is attained through this overaging processing. Although surface deterioration prevention the existence of the lower limit of the amount of C, aluminum, Nb, etc. is carried out by grain refining of crystal grai especially Nb addition of a minute amount improves processability by demonstrating a reduction operation of the dissolution C and N conjointly with overaging processing.

[0011] If a pace of expansion is the range which is 0.5 - 2.0%, since generating of a stretcher strain will be prevented this range is suitable for temper rolling temper rolling (the abbreviation for SR and Single Reduce Rolling). While reducing the dissolution C and N in the aforementioned steel by overaging processing, suppressing generating of the vena contracta, and connection of a void, improving the processability in deep drawing and filling with this invention the processing conditions of thinning deep drawing which is the object of this invention By performing temper rollin of the range whose pace of expansion is 0.5 - 2.0%, intensity can be given and the steel plate of this invention can gi the board intensity which combines with the advanced processability for which thinning deep drawing is asked, and does not produce body-breaking generating at the time of processing by this. Thus, in this invention, these two processes are put together and the conditions of processability and each board intensity can be attained. Moreover, th necessary can intensity called for in the can of ultra-thin ** by this temper rolling is also attained.

[0012] Although especially DR rolling DR rolling may be performed when giving the can intensity after fabrication, rolling reduction may be 20 - 50%. At less than 20%, if sufficient can intensity is not obtained but 50% is exceeded, steel plate will serve as high intensity and difficulty will be caused to a can fabricating operation. DR rolling is Doub here. Reduce Rolling It is abbreviation and is the rolling-out method to which decrease board thickness more positiv and board intensity is made to increase from temper rolling. In this invention, it considers as secondary cold-rolling including the above-mentioned temper rolling and DR rolling.

[0013] Next, as a steel plate used for this invention, what performed surface treatment is raised to the steel plate of th shape of the shape of a sheet, and a coil, steel foils, those steel plates, etc. That by which a chromium hydration oxid or the upper layer performed surface treatment with the two-layer structure where a chromium hydration oxide and a lower layer consist of a metal chromium layer to an electrolysis chromate-treatment steel plate [ in which a lower lay has metal chromium and the upper layer has the two-layer structure of a chromium hydration oxide especially ] or ultra-thin tin plated steel plate, and nickel-plating steel plate, galvanized steel sheets, and these plating steel plates is excellent in contact nature with polyester resin.

[0014] Specification of the diameter of the diameter crystal grain of average crystal grain is explained based on drawing 1 and drawing 2 . Drawing 1 shows the relation between the diameter of average crystal grain, and the surfa deterioration nature of the can side attachment wall after canning processing. Drawing 1 shows that the surface deterioration nature of the front face after canning processing deteriorates, when the diameter of average crystal grai becomes large. If the diameter of average crystal grain exceeds 6 micrometers, surface surface deterioration nature w deteriorate and the appearance and the property as a can will be spoiled. For this reason, the diameter of average crys grain decides not to exceed 6 micrometers. Moreover, drawing 2 shows the relation between the diameter of average crystal grain, and corrosion resistance. It turns out that corrosion resistance is good in the range in which the diamete of average crystal grain does not exceed 6 micrometers from drawing 2 , either. In addition, corrosion resistance evaluation was performed as follows. Heat treatment for 20 minutes was performed for the can after canning process at 130 degrees C, it was filled up with water, and viewing estimated the corrosion (melanism) grade of the can inside

after 37 degrees C and the two-week passage of time.

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EXAMPLE

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[Example]
[0016]
[Table 1]

| 鋼種記号 | 鋼の化学成分 (wt%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | C | Si | Mn | P | S | Sol. Al | N | Nb |
| A | 0.06 | 0.03 | 0.35 | 0.011 | 0.011 | 0.044 | 0.0022 | – |
| B | 0.08 | 0.02 | 0.42 | 0.015 | 0.013 | 0.049 | 0.0033 | – |
| C | 0.11 | 0.01 | 0.56 | 0.018 | 0.010 | 0.035 | 0.0027 | – |
| D | 0.15 | 0.03 | 0.60 | 0.010 | 0.010 | 0.052 | 0.0063 | – |
| E | 0.01 | 0.01 | 0.15 | 0.016 | 0.016 | 0.047 | 0.0023 | 0.018 |
| F | 0.03 | 0.02 | 0.21 | 0.013 | 0.012 | 0.043 | 0.0031 | 0.002 |
| G | 0.002 | 0.01 | 0.18 | 0.009 | 0.013 | 0.052 | 0.0035 | – |

[0017]
[Table 2]

| | No | 鋼種記号 | 二次冷延 | 焼鈍条件 | 平均結晶粒径（μm） | 肌荒れ性 | 耐食性 | 加工性 | 総合評価 |
|---|---|---|---|---|---|---|---|---|---|
| 本発明 | 1 | A | SR | 有 | 5．5 | ○ | ○ | ○ | ○ |
| | 2 | B | DR | 有 | 5．3 | ◎ | ◎ | ○ | ◎ |
| | 3 | C | DR | 有 | 4．8 | ◎ | ◎ | ○ | ◎ |
| | 4 | D | SR | 有 | 4．3 | ◎ | ◎ | ○ | ◎ |
| | 5 | E | DR | 有 | 5．3 | ◎ | ◎ | ◎ | ◎ |
| | 6 | F | DR | 有 | 6．0 | ◎ | ◎ | ◎ | ◎ |
| 比較例 | 7 | G | DR | 有 | 8．3 | × | × | △ | × |
| | 8 | B | SR | 無 | 5．2 | ◎ | ◎ | △ | △ |
| | 9 | C | DR | 無 | 4．8 | ◎ | ◎ | △ | △ |
| | 10 | D | DR | 無 | 4．2 | ◎ | ◎ | △ | △ |

焼鈍条件：過時効処理を実施しているものを有とした

過時効処理を実施してないものを無とした

[0018] Example No.1-6 of an evaluation this invention are carrying out overaging processing, and they are excellent processability with component within the limits of this invention. The diameter of average crystal grain is 6.0 micrometers or less as shown in Table 2, and it turns out that it excels also with surface deterioration nature and corrosion resistance. Moreover, a result which was excellent also in processability important as a thinning deep-drawing can use of this invention is brought. It turns out that it reaches example No.5 and 6 is especially excellent in processability with Nb addition of a minute amount. On the other hand, example No.of comparison 7 have brought a result which was inferior also in processability, although crystal grain became big and rough, became poor [ surface deterioration nature and corrosion resistance ] and performed overaging processing, since there were few amounts of below at the minimum of this invention range. Although example No.of comparison8-10 are in the component range invention, they do not carry out overaging processing but are inferior in processability. In addition, the evaluation ca was performed as follows here, respectively. Evaluation of surface deterioration nature measured the surface roughn of the can side attachment wall of the can inside after thinning deep-drawing can fabrication, Ra made 1 micrometer less O (best), and it made the 1-1.5-micrometer thing O (good), made the 1.5-2-micrometer thing ** (a little poor), a evaluated 2 micrometers or more as x (poor). Moreover, corrosion resistance evaluation performed heat treatment fo 130 degree-Cx 20 minutes after thinning deep-drawing can fabrication, it was filled up with water, and 37 degrees C estimated the corrosion (melanism) grade of the can inside after the two-week passage of time visually. That in whic the front face has not carried out melanism at all was made into O (best), the grade of melanism made the minute thi O (good), the range of melanism made the thing (diameter of 5mm or less) of smallness ** (a little poor), and the thi of size (diameter of 5mm or more) was evaluated as x (poor). The size of ********** until it raises and carries ou body breaking of the ********** at the time of thinning deep-drawing can fabrication estimated evaluation of processability. What made O (good) what ********** made what carried out body breaking by 5t or less ** (a lit poor), and carried out body breaking by 5-7t, and carried out body breaking by 7t or more was made into O (best).

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]
[Drawing 1] It is the graph which shows the influence of the diameter of average crystal grain exerted on surface deterioration nature.
[Drawing 2] It is the graph which shows the influence of the diameter of average crystal grain exerted on corrosion resistance.

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DRAWINGS

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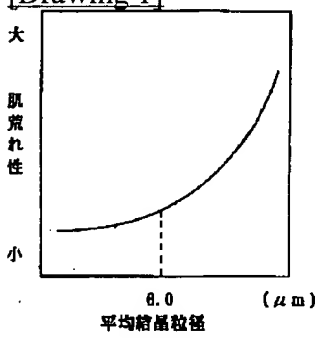
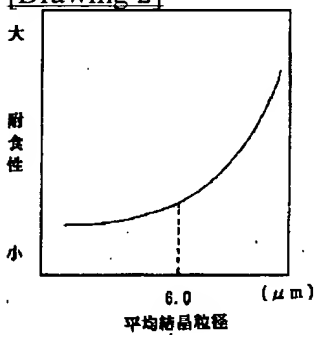
[Drawing 1]




[Drawing 2]

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CORRECTION or AMENDMENT

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[Official Gazette Type] Printing of amendment by the convention of 2 of Article 17 of patent law.
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C22C 38/00 301 .
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C22C 38/06 .
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C22C 38/00 301 S .
C21D 9/48 H .
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38/12 .

[Procedure revision]
[Filing Date] February 2, Heisei 12 (2000. 2.2)
[Procedure amendment 1]
[Document to be Amended] Specification.
[Item(s) to be Amended] Claim.
[Method of Amendment] Change.
[Proposed Amendment]
[Claim(s)]
[Claim 1] C:0.01 - 0.15%, Si<=0.05%, Mn<=0.9%, P<=0.04%, S<=0.04%, aluminum:0.015-0.10%, N:0.0020 - 0.015%, Annealing by the thermo cycle which includes cold rolling and overaging processing for the hot rolled shee steel which consists of the remainder Fe and an unescapable impurity, The resin covering steel plate suitable for the thinning deep-drawing can use which performed temper rolling with a pace of expansion of 0.5 - 2.0% one by one, a covered the resin film at least on one side of the steel plate whose diameter of average crystal grain of the steel plate after temper rolling is 6.0 micrometers or less.
[Claim 2] C:0.01 - 0.15%, Si<=0.05%, Mn<=0.9%, P<=0.04%, S<=0.04%, aluminum:0.015-0.10%, N:0.0020 - 0.015%, The hot rolled sheet steel which consists of the remainder Fe and an unescapable impurity Nb:0.001-0.020% The resin covering steel plate suitable for the thinning deep-drawing can use which performed annealing by the therm cycle including cold rolling and overaging processing, and temper rolling with a pace of expansion of 0.5 - 2.0% one by one, and covered the resin film at least on one side of the steel plate whose diameter of average crystal grain of th steel plate after temper rolling is 6.0 micrometers or less.

[Claim 3] C:0.01 - 0.15%, Si<=0.05%, Mn<=0.9%, P<=0.04%, S<=0.04%, aluminum:0.015-0.10%, N:0.0020 - 0.015%, Annealing by the thermo cycle which includes cold rolling and overaging processing for the hot rolled shee steel which consists of the remainder Fe and an unescapable impurity, The thinning deep-drawing can which perform temper rolling with a pace of expansion of 0.5 - 2.0% one by one, and was formed at least in one side of the steel pla whose diameter of average crystal grain of the steel plate after temper rolling is 6.0 micrometers or less from the resi covering steel plate which covered the resin film.
[Claim 4] C:0.01 - 0.15%, Si<=0.05%, Mn<=0.9%, P<=0.04%, S<=0.04%, aluminum:0.015-0.10%, N:0.0020 - 0.015%, The hot rolled sheet steel which consists of the remainder Fe and an unescapable impurity Nb:0.001-0.020% The thinning deep-drawing can which performed annealing by the thermo cycle including cold rolling and overaging processing, and temper rolling with a pace of expansion of 0.5 - 2.0% one by one, and was formed at least in one sid of the steel plate whose diameter of average crystal grain of the steel plate after temper rolling is 6.0 micrometers or less from the resin covering steel plate which covered the resin film.

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[Translation done.]